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ABSTRACT

Reported is a needs assessment study designed to determine priority needs for a college Department of Civil and Environmental Engineering for setting objectives and long range planning. Opinions were obtained from students, graduates, faculty, and employers. Each of the groups showed agreement on three priority items: (1) practical managerial skills; (2) communication skills; and (3) thinking skills. Discrepancies among the four groups are also reported. Conclusions of the study present a summary of the results. (RH)

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An Assessment of Educational Needs for the Department of Civil and Environmental Engineering

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SE 022 537

AN ASSESSMENT OF EDUCATIONAL NEEDS FOR THE DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Submitted To The
Department of Civil and
Environmental Engineering

by

J. Nicholls Eastmond, Jr.
Division of Instructional Development
Merrill Library and Learning Resources Program
May, 1975

FOREWORD

Working with an entire department in instructional development activities, as has been done this year with the Department of Civil and Environmental Engineering, represents a new thrust for the Division of Instructional Development. This study, conducted in cooperation with the Civil Engineering Curriculum Revision Committee, represents a departmental effort.

This study provides a formal, largely empirical, statement of educational needs for the Civil Engineering program at Utah State University. These needs offer an indication of priority for departmental emphasis in long-range planning efforts.

The four main groups surveyed and the numbers of each sampled are indicated below:

1. Senior students, Class of 1975 28
2. Faculty members of Civil Engineering Department 23
3. Graduates of the Department, since 1970-71 55
4. Employers of these graduates (Immediate Supervisors) 22

Questionnaire data from these 128 respondents forms the basis for this report.

In addition, a summary of results of the professional licensing examination, the Engineer-In-Training (E.I.T.) Examination, has been included. A brief literature search of sources related to current Civil Engineering topics is also included in Appendix C. Both the

E.I.T. results and the literature search are meant to provide objective data in addition to the more subjective surveys of opinion.

Grateful acknowledgment is extended to Dr. Roland W. Jepson, Department Head, and to Drs. Vance T. Christiansen, Gordon H. Flammer (Chairman), Fred W. Kiefer, and Elliot Rich as members of the Curriculum Revision Committee for their cooperative and enthusiastic support in making the needs assessment possible.

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Associate Director
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ABSTRACT

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The needs assessment study sought to determine priority needs for the Department of Civil and Environmental Engineering, as a basis for the setting of objectives and for long-range planning . . i

The Civil Engineering Curriculum Revision Committee provided as assurance of quality in the needs assessment study 2

Polling of opinion was conducted for the following groups, with numbers of usable return given in parentheses: senior students (28), faculty (23), graduates (55), supervisors (22) 3

The data were analyzed by subtracting the average "performance" score from the average "importance" score and then ranking by magnitude of the difference 4

An examination of the priority items for each of the four groups of respondents showed three major areas of agreement: (1) practical, managerial skills; (2) communication skills; and (3) thinking skills 7-9

The one item with highest priority among all groups was that of providing "engineering management experience and skills" 7

"Skill in technical report writing" and "effective use of English" were ranked high by faculty, graduates, and supervisors. By contrast, senior students gave these items fairly low priority rankings. However, all four groups ranked speaking skills as quite high in priority 8

The ability to "think independently and to arrive at creative solutions to problems" was ranked higher by supervisors and faculty than by graduates and seniors. Additional skills in "critical thinking and use of judgment" and "planning and forecasting future trends" were ranked somewhat lower 9

The amount of discrepancy between "importance" and "performance" differed for the four groups. Taking the size of this gap as an indication of relative dissatisfaction with the present program, the faculty was found to be most critical, followed by senior students, graduates, and employers . . . . . .

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The USU average scores on the Engineer-In-Training Examination were found to be consistently above the State of Utah means, and the Utah mean scores were consistently above the national norms for the same period (1972-74) 10

Two concerns of national interest at this time--meeting the special learning needs of minority and women students--received fairly low priority rankings by all groups polled. A reconsideration of these items may be warranted 13

Suggested next steps for use of these findings involve curriculum and program emphases in the department . . . . . .

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*Note: Appendices have been published separately and are available upon request from the Division of Instructional Development.

METHODS AND PROCEDURES

This study attempted to identify systematically the most critical educational needs facing the Utah State University Civil Engineering Department at the present time. The methods employed attempted to involve large numbers of students, faculty, graduates, and supervisors of graduates.

Planning and Quality Assurance

The needs assessment was undertaken in November, 1974, to identify the department's most critical needs. Following a preliminary presentation of the idea and acceptance of it by members of the Civil Engineering Department Curriculum Revision Committee, the study was undertaken. Throughout the course of the needs assessment, this group provided leadership and coordination of the various activities, as well as serving in an overseeing role for quality assurance purposes.

The Polling of Opinion

The use of scientific polling techniques provided the main source of data for the needs assessment. Beginning with a preliminary statement of departmental goals and objectives (See Appendix A) and a brief survey of engineering literature, an initial questionnaire was drafted. Following several revisions, a final polling instrument was obtained. Briefly, the actual gathering of opinion was handled as follows:

1. Senior Students. Questionnaires were distributed in a class attended by all seniors during fall quarter, 1974. Students were asked to fill the questionnaires out at home and bring them back to class, to be marked off in the instructor's roll. The rate of return for senior students, 28 out of 34, or 83 percent, represents the highest rate of return of any of the groups.

2. Faculty. Questionnaires were distributed in faculty meeting, and the purpose of the needs assessment explained, during the week of November 22, 1974. Follow-up letters were sent out prior to Christmas vacation, and results were tabulated by January 15, 1975. The rate of return of 72 percent, 23 of 32 faculty members, was obtained.

3. Graduates. Beginning with a department list of the names and addresses of Civil Engineering graduates since 1970, letters explaining the purpose of the survey and asking for cooperation in conducting the survey were sent out. Graduates were asked to indicate (1) their willingness to fill out a questionnaire themselves; (2) the name of their immediate supervisor and permission for him to be surveyed; and (3) the names and addresses of any fellow USU graduates if different from that given on the address list for their class (enclosed). After the initial reply had been returned, a questionnaire was mailed out. Of the 148 questionnaires sent out, 55 or 37 percent, were returned.

4. Supervisors. Prior to mailing a questionnaire to employers, they were asked to indicate their willingness to participate on return postcard. A questionnaire was then mailed out. An additional follow-up letter was sent to improve the response rate. Of 62 questionnaires mailed, 22 of them (35 percent) were returned.

Analysis of Data

The questionnaire called for a response to each item in two columns: to "respond by both rating the present performance of the Civil Engineering Department on the scale of 'successful to unsuccessful' and according to the importance . . . perceive(d) for each concern, from 'important to unimportant.'" Finally, they were asked to "mark in the final column if you do not know."

For each of the four groups, averages were computed on the ranking of each item according to performance and importance. Then the numerical difference between the two scores was found by subtracting the average "performance" score from the average "importance" score. Based upon the size of this difference, items were ranked.

How are these scores to be interpreted? A need, for the purposes of needs assessment, is defined as the difference between "what is" and "what should be."[1] In other words, it is the difference between a value and a fact, in this case between "importance" and "performance." The larger the gap, the bigger the discrepancy between what is desired and what is actual. Based upon the size of this gap, items could be ranked with the largest discrepancy ranked highest and so on.

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[1]United States Office of Education, "Criteria for Determining the Quality of An Educational Needs Assessment Strategy, Washington, D.C., 1970.

RESULTS

The results of the survey for each group polled--senior students, faculty, graduates, and supervisors--is reported in detail in Appendix B. Besides giving a ranking of needs in order of criticality, from highest to the lowest for the two sections of the questionnaire, the results from the free response section have been included. In many cases, the candid comments of people intimately acquainted with the program are more convincing and explicit than extensively refined data. This material, however, is quite lengthy, sometimes contradictory, and not easily summarized. The reader is invited to examine the free-response statements contained in Appendix B for additional insights into departmental operations from a variety of viewpoints.

As an aid to simplifying the data interpretation, the thirteen top ranked items for each of the four groups are shown in Table 1. An analysis of these lists will show a surprisingly large number of items of agreement among the four groups. Remember that these represent the top thirteen rankings from a total list of forty-sever items. In examining those nine items which fall in the top thirteen rankings for three or more of the four groups, the items seem to cluster logically into three groups.

Table 1

SUMMARY OF NEEDS ASSESSMENT FINDINGS: THE THIRTEEN TOP RANKED ITEMS FROM EACH GROUP, GIVING QUESTION NUMBER, DIFFERENCE SCORE, AND ITEM

Seniors

I	D	
I.15	1.72	Equipment & resources
II.17	1.62	Extensive orientation
I.17	1.50	Motivate to update skills
I.7	1.45	Speaking skills
I.16	1.44	Current thinking
II.8	1.38	Elective courses
II.15	1.36	Planning & forecasting
I.24	1.31	Eng. Management skills
I.14c	1.27	Favorable attitudes towards himself
I.22c	1.22	Meet employer's expect.
II.1	1.20	Aesthetics in design
I.13	1.18	Ability to define & solve practical probs.
I.12	1.17	Ability to work with other disciplines

Faculty

I	D	
II.3	2.09	Effective use of Engl.
I.6	1.86	Tech. report writing
II.14	1.80	Library research skills
I.5	1.59	Indep. thinking & creativity
I.10	1.59	Critical think. & judgment
I.24	1.55	Eng. management skills
II.15	1.49	Planning & forecasting
I.7	1.35	Speaking skills
I.17	1.28	Motivate to update skills
I.9	1.24	Prof. standards & ethics
I.4	1.23	Solve probs. systematically
II.18	1.20	Political affairs
I.12	1.20	Communication with other disciplines

Graduates

I	D	
I.24	1.44	Eng. management skills
I.6	1.35	Tech. report writing
I.15	1.22	Equip. & resources
I.3	1.18	Effective English
I.7	1.06	Speaking skills
I.12	1.05	Communication with other disciplines
II.4	1.02	Current events
II.16	1.01	Involvement with prof. organizations
I.10	.99	Critical think. & judgment
II.1	.92	Aesthetics in design
II.14	.91	Library research skills
I.5	.86	Indep. think. & creativity
I.13	.85	Define & solve practical engineering probs.

Supervisors

I	D	
I.24	.90	Eng. management skills
I.5	.89	Indep. think. & creativity
I.6	.76	Tech. report writing
II.3	.66	Effective English
II.15	.64	Planning & forecasting
I.10	.61	Critical think. & judgment
I.13	.37	Define & solve prac. probs.
I.4	.35	Solve probs. systematically
I.16	.33	Current thinking
I.15	.32	Equipment & resources
I.7	.31	Speaking skills
II.1	.30	Aesthetics in design
I.14b	.27	Favorable attitudes towards work

Practical, Managerial Skills

The first of these groups could be entitled, "Practical, Managerial Skills." a graph of this ranking is shown in Figure 1.

Clearly, the one item with the highest priority among all groups is that of providing "engineering management experience and skills." Both graduates and their supervisors by their ratings ranked this item as the highest in priority, with faculty and senior students ranking this area sixth and eighth respectively. Another item, that of providing "a working knowledge of equipment and resources available to the practicing engineer," is ranked in first place by senior students and third by graduates, but considerably lower (tenth and twenty-eighth respectively) by supervisors and faculty. An examination of the free-response items for these groups shows a large number of statements dealing with practical experience in engineering as an important, but often overlooked element, in undergraduate engineering education.

Communication Skills

A second cluster of items dealing with various communication skills is shown in Figure 2. Particularly noteworthy is the consistency of agreement among graduates, faculty, and supervisors that skill in technical report writing is an item of major concern--ranked second in importance by graduates and faculty and third by supervisors. By contrast, senior students do not view this item as being particularly critical at this time, ranking it as thirty-fifth in importance.

A very similar response pattern was obtained to a related question regarding the effective use of English. Faculty ranked this as number one priority, while both graduates and supervisors ranked it fourth. Senior students ranked it twenty-sixth. Evidentally, students in the

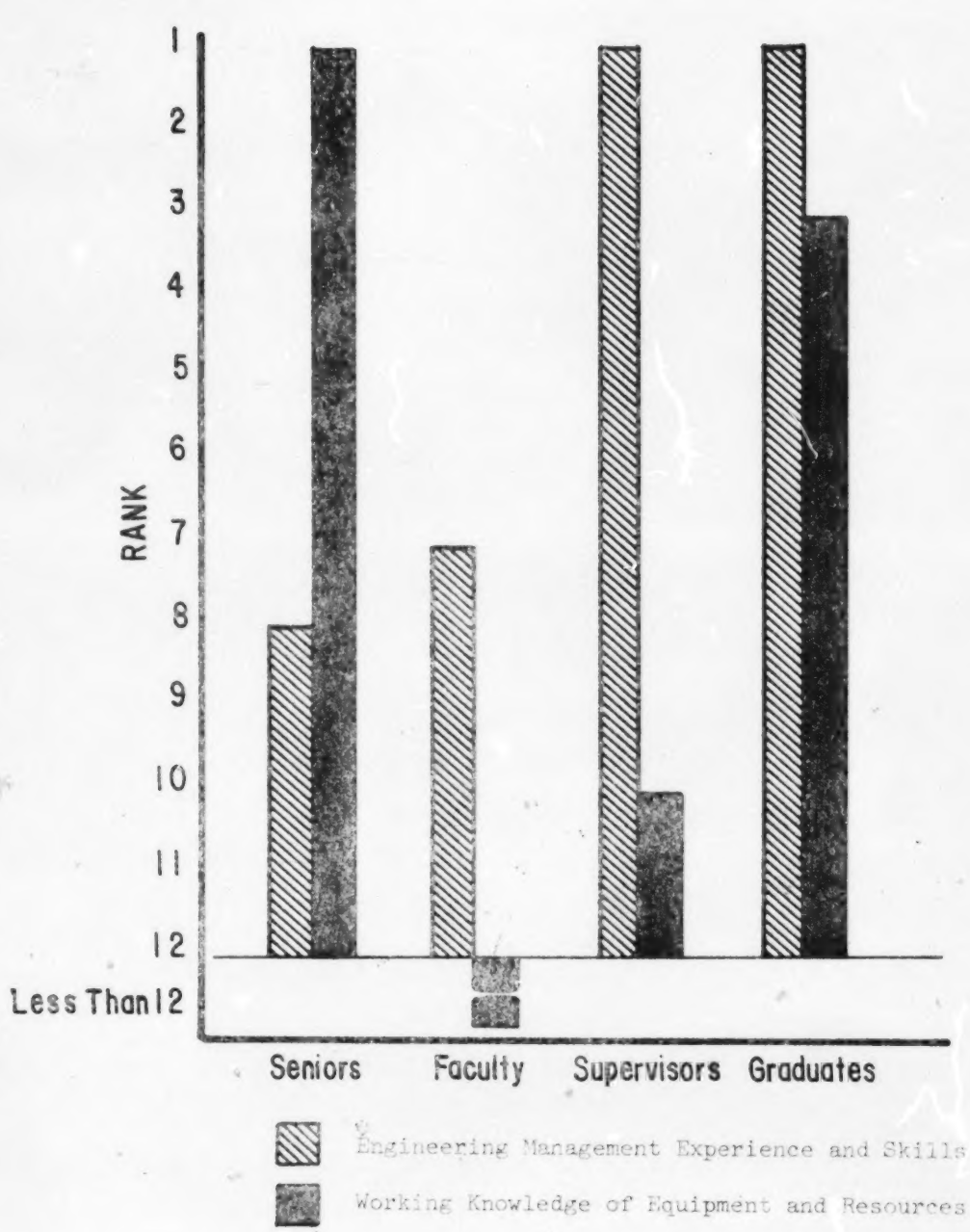


FIGURE 1: Rankings On Criticality of Practical and Management Skills

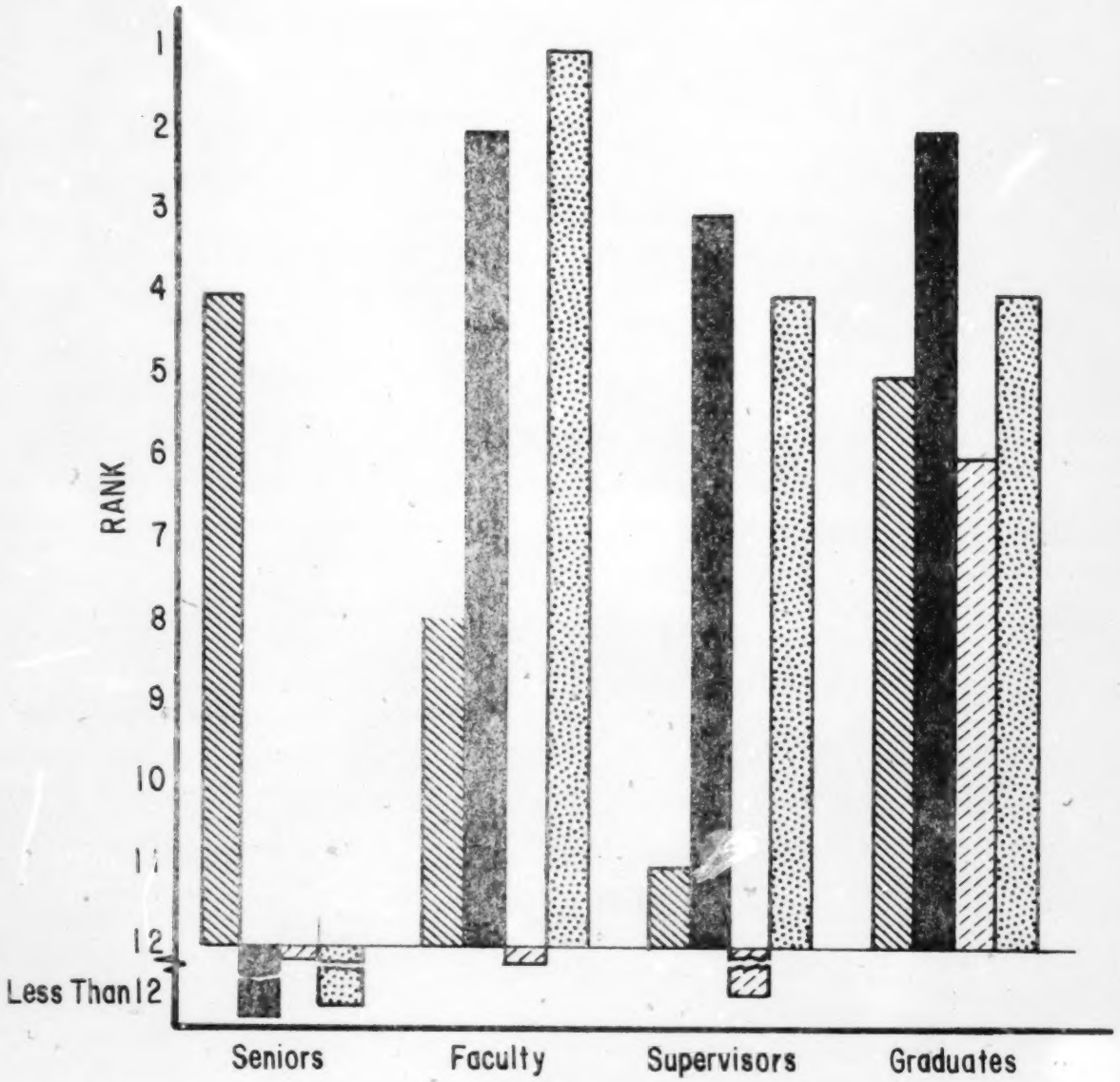


FIGURE 2: Rankings On Criticality of Communication Skills

program do not regard this area of written communications skills as being nearly as crucial as do faculty members or graduates or their supervisors.

There is reasonable concensus among the four groups, however, regarding the priority of action on speaking skills. All groups rank it in the top ten, with seniors and graduates ranking it highest (fourth and fifth respectively).

A final concern relating to communication, ranked considerably lower than the others mentioned above, is the ability to communicate with others outside the discipline of engineering. Graduates ranked this item sixth, but all other groups ranked it eleventh or lower.

Thinking Skills

A final cluster of skills relates to certain thinking skills. The ranks for each are shown in the table below and graphically in Figure 3.

Table 2

RANKINGS BY GROUPS OF PARTICULAR THINKING SKILL ITEMS
(Rankings Below Twelfth Shown In Parentheses)

		Seniors	Graduates	Supervisors	Faculty
I.5	The ability to think independently and to arrive at creative solutions to problems	(18)	12	2	4
I.10	Skill in critical thinking and use of judgment	(17)	9	6	5
II.15	Skills in planning and forecasting future trends	7	(27)	5	7

With the possible exception of the fairly high ranking by faculty and supervisors of "independent thinking and creative solutions," these items do not receive as high priority ranking as do several in the previous sections. However, in the free response section dealing with seven steps of systematic problem solving, a large number indicated a need for more divergent thinkink, an examination of questions with more than one answer, and an end to "cookbook" solutions.

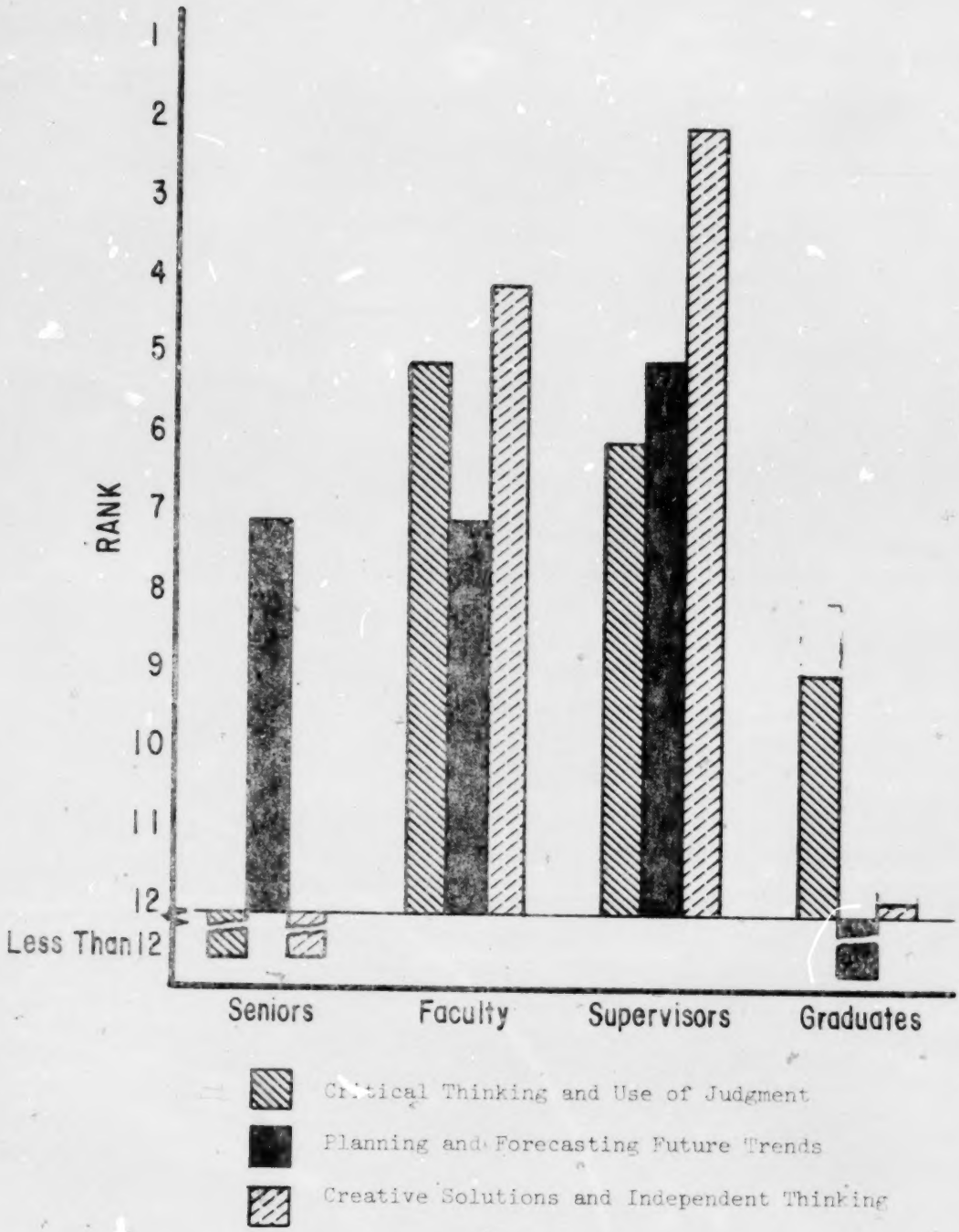


FIGURE 3: Rankings On Criticality of Various Thinking Skills

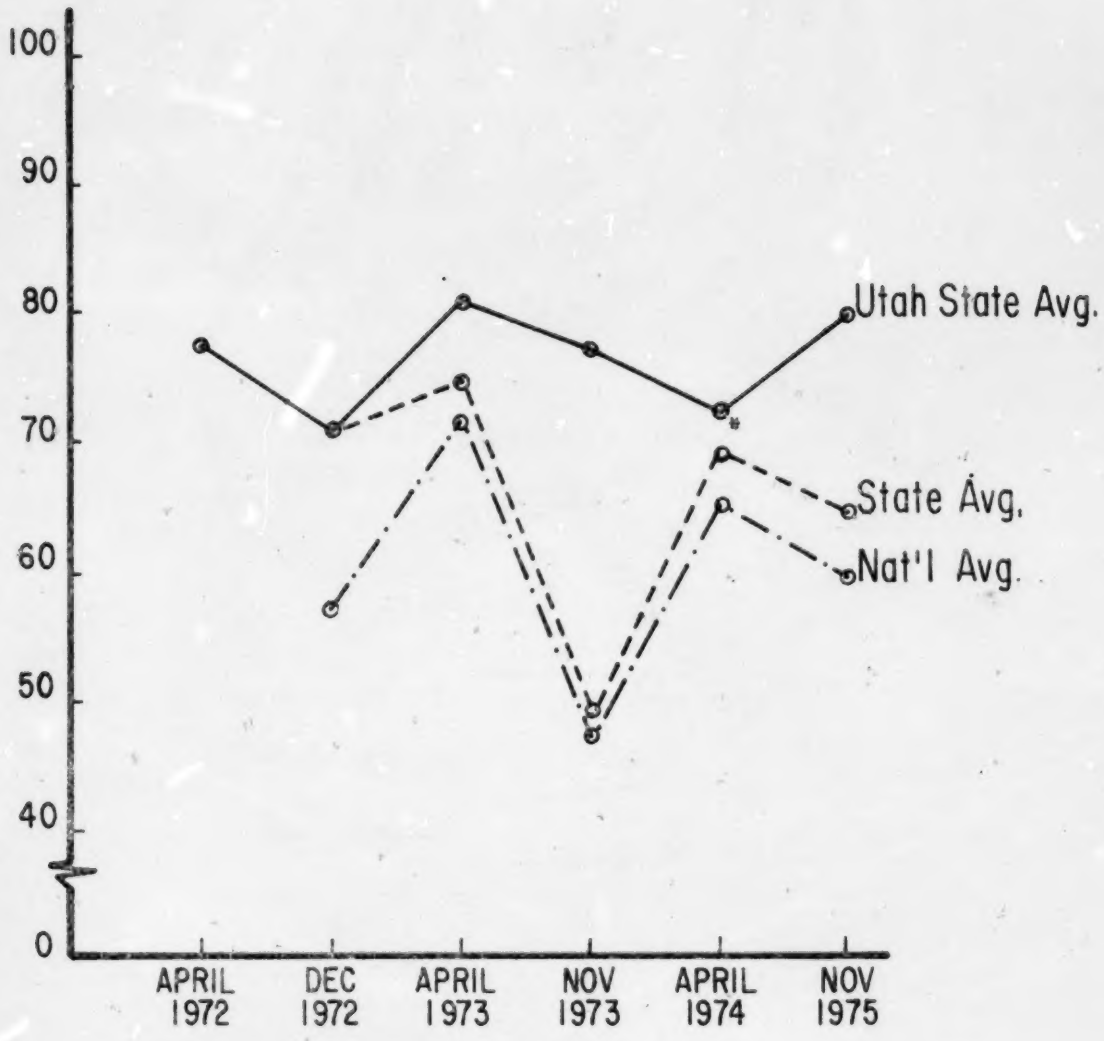
Relative Dissatisfaction With Present Program

In addition to examining the three major groupings of concerns, it is useful to examine the size of the difference between average "performance" and "importance" scores for the four groups. To some extent, the size of the largest gaps may indicate a degree of dissatisfaction or willingness to criticize. The range of this difference score for the top thirteen ranked items gives a definite pattern for the four groups. Faculty members are generally the most critical (with differences of 2.09 to 1.20) followed by senior students (1.72 to 1.17), graduates (1.44 to .85) and finally, least critical were supervisors (.90 to .27). This pattern could indicate that faculty members and senior students are most outspoken about program failings, or that the other groups lack the familiarity with the present program to criticize strongly. In any case, a seeming pattern of stronger criticism from those within the university than from those without it should be considered a healthy sign for the organization.

Some Comments On The E.I.T. Examination Results

Comparisons based upon the average (mean) scores on the Engineer-In-Training Examination during the period from April, 1972 to November, 1974 are fairly straightforward. State, local, and national mean scores are shown in Table 3 and portrayed in graphic form in Figure 4.

Those Civil Engineering majors taking the E.I.T. exam clearly score higher than the national or the state average. With the exception of the December, 1972 exam, when USU and the State of Utah means are essentially tied, Utah's scores are consistently above the state mean. That many of those surveyed recognized this level of academic performance--assuming that is what the E.I.T. measures--could account



*No e: This score includes only those who passed

FIGURE 4: A Comparison of Average Scores On The Engineer In Training Examination, April 1972-November 1975

for the rather unusual finding of higher performance than importance scores on the opinion question of the USU department having "standards which meet the expectations of the academic community on campus." Faculty and graduates by their response in ranking this question last seemed to be s ing that meeting these standards is definitely not a priority need and may in fact be over emphasized. (See Appendix B.)

Table 3

Local, State, and National Mean Scores
Of Students Taking The EIT Exam, April 1972-November, 1974
(Numbers of students are shown in parentheses)

Date of Exam	Mean Score, USU C.E. Dept.	Mean Score, State of Utah	Mean Score, National (For those holding or about to receive B.S. degree)
April, 1972	77.54 (22)	----	----
December, 1972	70.4 (8)	70.8 (NA)	69.33 (5109)
April, 1973	80.67 (12)	76.25 (NA)	73.64 (9190)
November, 1973	77.42 (14)	48.69 (NA)	46.99 (6346)
April, 1974	73.60* (14)	68.18 (NA)	65.25 (13289)
November, 1974	79.96 (23)	63.71 (NA)	59.55 (6846)

*Score for USU, April 1974, includes only those who passed the exam.

Some Items Measuring Low Priority Which Are Receiving National Attention

A group of articles in current popular and engineering periodicals were reviewed and some salient points are quoted under Engineering Department Facts given in Appendix C. Of particular interest are those relating to ethnic minorities and women.

The Utah State University survey saw virtual agreement among faculty and senior students that providing for the special learning needs of women and minority students were not major priorities. In each case these rankings were found in the bottom half of the list.

On the national scene, however, both items are receiving considerable attention. For example, the Alfred P. Sloan Foundation plans to spend $12-15 million over the next five to seven years to build up the number of freshmen minority students. A number of universities across the nation are making special recruiting efforts to bring in both women and minority students. In view of such emphasis, further consideration of these items may be in order for Utah State University.

Suggested Next Steps

The needs assessment study was designed to determine the skill areas of engineering students seen as most critical for change. The study's primary value is in giving a focus to efforts of the Civil Engineering Department in the most pressing skill areas.

It is proposed that the needs assessment findings form the basis for a revised statement of departmental goals and objectives. While the existing statements as to goals may reflect what is important--and the data are available to check this--the additional concerns uncovered in the needs assessment suggest areas for program change. This study

calls for a redirection of emphasis--toward an increase of practical managerial skills, toward a heightened concern with the communication skills of writing and speaking, and toward thinking skills involving creativity, independence, criticality, and judgment. This study provides a challenge and a suggested direction for the Curriculum Revision Committee and the Civil Engineering Department.

CONCLUSIONS

A needs assessment purposely stops short of providing suggestions as to the best ways to resolve needs. Rather, it attempts simply to document the existence of discrepancies between "what is" and "what should be," i.e., to point out needs. This study in the Department of Civil Engineering has noted nine such needs, as cited by three of the four major groups surveyed.

These needs can best be viewed under three general headings, as indicated below. The four needs clearly cited as most critical are underlined.

1. Practical and Managerial Skills
   a. Engineering management experience and skills.
   b. A working knowledge of equipment and resources available to the practicing engineer.
2. Communication skills.
   a. Skill and practice in technical report writing.
   b. Skills in the effective use of English (spelling, punctuation, and grammar).
   c. Speaking skills.
   d. Knowledge and ability necessary to work and communicate with other disciplines involved in the solution of engineering problems.
3. Thinking skills.
   a. The ability to think independently and to arrive at creative solutions to problems.
   b. Skill in critical thinking and the use of judgment.
   c. Skills in planning and forecasting future trends.

In light of the E.I.T. examination results, where USU students consistently score above the state and national averages, it would seem that technical training is adequate. Additional emphasis in some of the above areas could provide a useful addition to the skills of Civil Engineering graduates. The specifying of specific goals and objectives and the implementation of long-range programs designed to meet these needs are subsequent steps to be taken.